

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
31 March 2005 (31.03.2005)

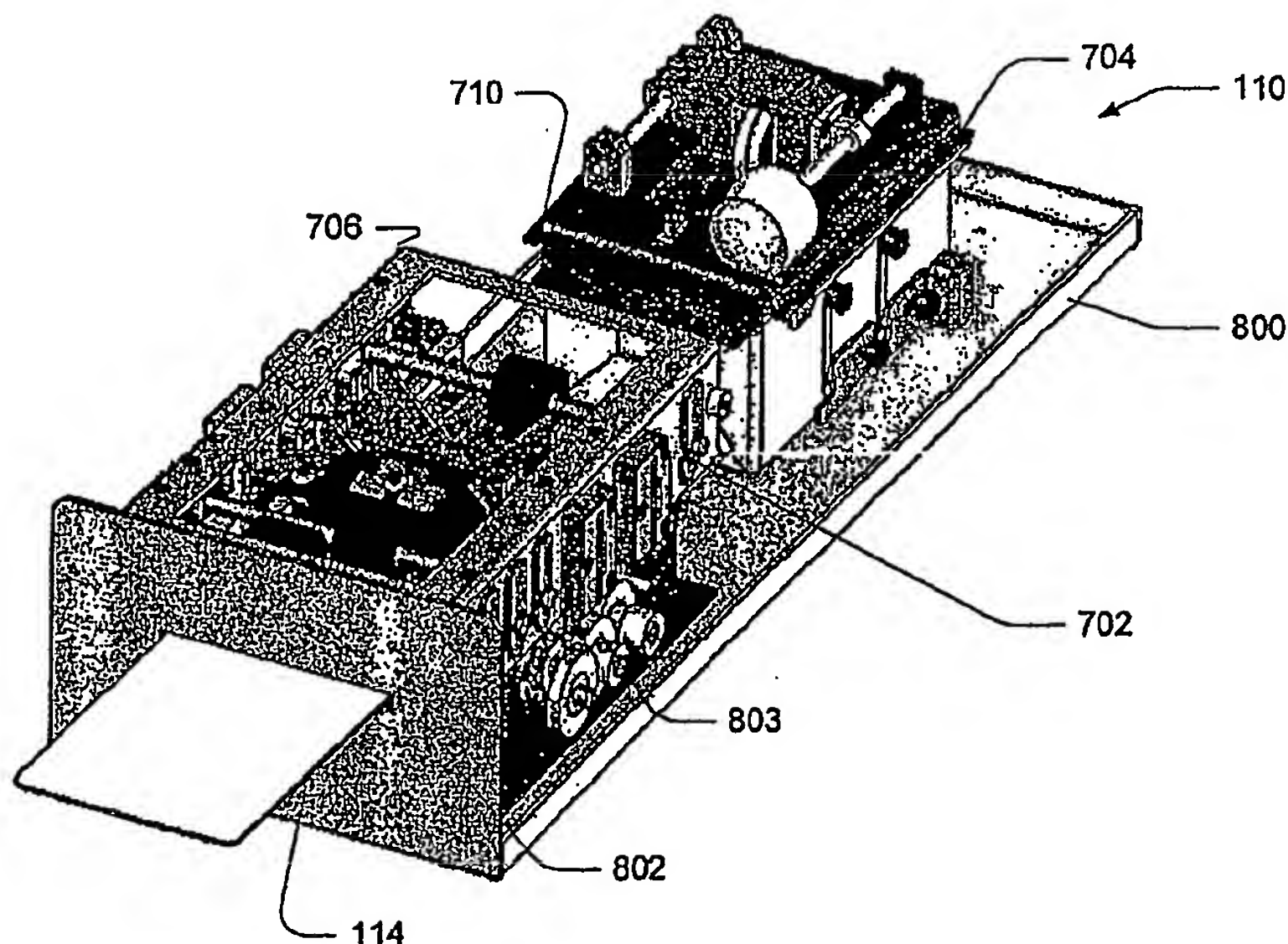
PCT

(10) International Publication Number  
**WO 2005/029238 A2**

- (51) International Patent Classification<sup>7</sup>: **G06F** 91011 (US). **HILBERT, John**; 3619 W. 187th Street, Torrance, CA 90504 (US).
- (21) International Application Number: PCT/US2004/029952 (74) Agents: **CIRE, Frank, L. et al.**; Fitzpatrick, Cella, Harper & Scinto, 30 Rockefeller Plaza, New York, NY 10112-3801 (US).
- (22) International Filing Date: 13 September 2004 (13.09.2004) (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 10/661,364 12 September 2003 (12.09.2003) US (84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI,
- (71) Applicant (*for all designated States except US*): **FUTURELOGIC, INC.** [US/US]; 425 East Colorado St., Suite 100, Glendale, CA 92054 (US).
- (72) Inventors: **MEYERHOFER, Eric**; 1030 Shafer Street, Oceanside, CA 92054 (US). **DYMOVSKY, Oleg**; 2328 Hercules Drive, Los Angeles, CA 20046 (US). **MEYERHOFER, Mark**; 5228 Escalante Drive, La Canada, CA

[Continued on next page]

(54) Title: MULTI-MEDIA GAMING PRINTER



(57) Abstract: A multi-media gaming printer. The multi-media printer may accept various kinds of voucher media, such as thermally writable medias, smart cards, or magnetic strip cards. The multi-media printer includes writing, reading, and erasing devices within the printer to manage and use the different types of media. In addition, the multi-media printer includes control logic and articulated printing mechanisms that prevent the multi-media printer from inadvertently manipulating a voucher in an inappropriate manner. The design of the multi-media printer is modular so that voucher media magazines may be replaced as needed.

WO 2005/029238 A2

BEST AVAILABLE COPY



SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Published:**

— *without international search report and to be republished upon receipt of that report*

1

5

10

15

## MULTI-MEDIA GAMING PRINTER

## BACKGROUND OF THE INVENTION

20 This invention relates generally to gaming printers and more specifically to printers for use in cashless gaming machines that use vouchers.

25 The gaming machine manufacturing industry provides a variety of gaming machines for the amusement of gaming machine players. An exemplary gaming machine is a slot machine. A slot machine is an electro-mechanical game wherein chance or the skill of a player determines the outcome of the game. Slot machines are usually found in casinos or other more informal gaming establishments.

30 Gaming machine manufacturers have more recently introduced cashless enabled games to the market and these have begun to find wide acceptance in the gaming industry. Cashless enabled games are so named because they can conduct financial exchanges using a mixture of traditional currencies and vouchers. Typically, a cashless enabled game  
35 has a gaming printer to produce vouchers and a voucher reader that supports automatic reading of vouchers. To coordinate the activities of multiple cashless enabled games, one or more cashless enabled games may be

1 electronically coupled to a cashless enabled game system  
that controls the cashless operations of a cashless enabled  
game.

5 When a player cashes out using a cashless enabled game  
coupled to a cashless enabled game system, the cashless  
enabled game signals the system and the system may determine  
the type of pay out presented to the player. Depending on  
the size of the pay out, the cashless enabled game system  
10 may cause the cashless enabled game to present coins in the  
traditional method of a slot machine, or the cashless  
enabled game system may cause a gaming printer in the  
cashless enabled game to produce a voucher for the value of  
the pay out. The voucher may then be redeemed in a variety  
15 of ways. For example, the voucher may be redeemed for cash  
at a cashier's cage or used with another cashless enabled  
game. In order to use the voucher in a cashless enabled  
game, the voucher is inserted into a voucher reader of  
another cashless enabled game at a participating casino and  
20 the cashless enabled game system recognizes the voucher,  
redeems the voucher, and places an appropriate amount of  
playing credits on the cashless enabled game.

Cashless enabled games have found an increasing  
acceptance and use in the gaming industry, both with players  
25 who enjoy the speed of play and ease of transporting their  
winnings around the casino and casinos who have realized  
significant labor savings in the form of reduced coin hopper  
reloads in the games, and an increase in revenue because of  
the speed of play. Practical field experience with printers  
30 used in cashless enabled games has illustrated that there  
are areas for improvement in the current printer designs and  
implementation. These areas in need of improvement include  
methods and means for printing and reading images on a  
variety of media using direct thermal, thermal transfer,  
35 smart card, magnetic media, and Radio Frequency  
technologies, and magazine type loading and unloading  
containers for new and exhausted media storage and/or  
replacement.

1

## DEFINITIONS

For the purposes of this document, the following  
5 definitions apply:

"Casino"- A casino in the traditional sense, or other place  
where gambling takes place.

10 "Slot Machine" or "Slot"- A casino electro-mechanical game  
of chance. A Slot Machine as it is known is a sub-set of  
such games.

"Game Voucher" - A media, such as paper, containing  
15 sufficient information to identify at a minimum, an amount  
of money and a validation number use to authenticate the  
transaction.

"Promotional Voucher" - A media, such as paper, containing  
20 sufficient information to identify at a minimum, a  
promotional event, a promotional reward to the player and  
validation information.

"Dot Impact Printer" - Also known as "Impact Printers"  
25 describe a printer which makes an image by striking an inked  
ribbon overlaid on plain paper with a small pin which  
essentially hammers the ink onto the paper to make a small  
dot. Impact printers, by their electro-mechanical nature,  
have a number of moving parts and make a characteristic  
30 grinding sound, such as the noise made by all older receipt  
printers.

"Thermal Printers" - A printer where paper with a heat  
sensitive side is imaged using a print head which applies  
35 heat in tiny dots (1/200th of an inch in size or smaller) in  
order to turn the area black. In this manner, all images are  
created by a series of tiny black dots. A widely known  
example of a thermal printer is the original fax machines.

1 "Thermal Transfer Printers" - A printer where a transfer  
ribbon is used to create images on the paper. The thermal  
print head, heats the transfer ribbon, in turn creating an  
5 image on the paper.

"Bill Acceptor" - A device which automatically accepts paper  
currency by scanning it and saving the paper currency within  
the machine. A coin change machine always has such a device  
10 on it, and more recently, so do all slot machines.

"Ticket Image" - The image(s) created on the paper by a  
common process of imaging dots on the paper.

15 "Smart Card" - A device that normally takes the form of a  
credit voucher size and contains electronic circuitry and an  
interface commonly known as a swipe interface as a means of  
electrically connecting to a reading device.

20 "Magnetic Media" - A device containing a magnetic stripe  
that is programmable and readable by sliding and/or placing  
the magnetic Stripe adjacent to a interface device, such as  
the magnetic stripe used on credit vouchers.

25 "Thermal Media" - A type paper with a heat sensitive side is  
imaged using a print head which applies heat in tiny dots  
(1/200th of an inch in size or smaller) in order to turn the  
area black.

30 "Thermal Reversible Media" - A type of paper or voucher  
containing a multi-stable thermal layer. This layer is  
stable in clear or opaque( black or other colors), depending  
on the amount of heat applied by the thermal print head.

35 "RF Fiber Media" - A type of paper or voucher containing  
Radio Frequency active elements that are grouped together in  
such a manner so as to provide information about the paper  
or voucher stock.

1

"RF ID Tag Media" - A type of paper or voucher containing a Radio Frequency circuit that can hold information and does not require a direct electrical connection as an interface connection.

"Write Once Media" - A definition referring to any media that can only be written on or imaged one time. Standard thermally active paper is an example.

10

#### SUMMARY OF THE INVENTION

A multi-media gaming printer is provided. The multi-media gaming printer can be integrated into a cash-less slot machine or promotional system in a casino that produces cash-out paper vouchers and/or print on demand player tracking card/vouchers capable of communicating with a game or a host. A multi-media printer may print, scan, encode magnetically and electronically, and otherwise interface with a wide range of media types.

20

In one aspect of the invention, the multi-media printer may accept various kinds of voucher media, such as thermally writable medias, smart cards, or magnetic strip cards. The multi-media printer includes writing, reading, and erasing devices within the printer to manage and use the different types of media. In addition, the multi-media printer includes control logic and articulated printing mechanisms that prevent the multi-media printer from inadvertently manipulating a voucher in an inappropriate manner. The design of the multi-media printer is modular so that voucher media magazines may be replaced as needed.

25

30

In another aspect of the current invention, the multi-media printer contains a means to print and scan the thermal images, not limited to barcodes, created on thermally reactive paper.

35

In another aspect of the current invention, the multi-media printer contains means to interface to a "smart card" used in slot machines for the convenience of player



1 identification, statistical information, playing credits and  
banking information

5 In another aspect of the current invention, the multi-  
media printer contains a means to interface with magnetic  
media for the convenience of player identification,  
statistical information, playing credits and banking  
information.

10 In another aspect of the current invention, the multi-  
media printer contains means to interface with thermal  
reversible media used in slot machines to convey credit  
amounts and other information of interest to a player of  
slot machines.

15 In another aspect of the current invention, the multi-  
media printer contains a means to interface with RF Fiber  
Media, the RF Fiber Media consists of radio frequency  
resonators, or fibers, that are randomly or pseudo-randomly  
placed on a carrying medium, the medium can be standard  
thermal paper or other suitable carrying medium, the  
20 collection of the resonators placed on the medium in the  
random manner form a relatively unique signature, the  
signature can be obtained by applying a electro magnetic  
signal, the signal typically in the radio frequency  
spectrum, as the signal is applied, each of the resonators  
25 produce a electro magnetic response to the signal, the  
response is received and the collection of all the responses  
form the signature, the signature either alone or in  
combination with other authentication means of game voucher  
and/or promotional voucher provide a increased certainty of  
30 the authentication.

In another aspect of the current invention, the multi-  
media printer contains a means to interface with RF ID Tag  
Media, the RF ID Tag Media contains the means to allow  
information to be written and read electronically, the  
35 information is used either alone or in combination with  
other authentication means of Game Voucher and/or  
Promotional Voucher provide an increased certainty of the  
authentication.



1

In another aspect of the current invention, the multi-media printer contains a means to provide a removable magazine type loading and unloading containers for new and exhausted media storage and/or replacement.

5

In another aspect of the current invention, the multi-media printer contains a means to provide a removable magazine type loading and unloading containers for new and exhausted thermal transfer ribbons and/or replacement.

10

In another aspect of the current invention, the multi-media printer contains a means to provide a slide in and slide out mechanism for removable magazine type loading and unloading containers for new and exhausted media storage and/or replacement.

15

In another aspect of the current invention, the multi-media printer contains a means to provide a slide in and slide out mechanism for removable magazine type loading and unloading containers for new and exhausted thermal transfer ribbons and/or replacement.

20

In another aspect of the current invention, the multi-media printer contains a means to print on write once media and scan the media to determine its content and write on the media repeatedly until the predefined writing zones are full, and the means to store the media inside of the multi-media printer for later retrieval.

25

In another aspect of the current invention, the multi-media printer contains a means to store blank write once media and/or other media.

30

In another aspect of the current invention, the multi-media printer contains a means to retrieve the blank write once media from the storage on demand and to print images on the media as directed by a game or a host.

35

In another aspect of the current invention, the multi-media printer contains a cleaning system used to clean the print head and thermal reversible, smart card, or write once media. The cleaning system may be internal to the multi-media printer or may be a removable cartridge that can be

1 placed in the multi-media printer for cleaning then removed  
after cleaning is complete.

5 In another aspect of the current invention, the multi-  
media printer contains a means to provide an articulating  
print head mechanism. The mechanism is used to adjust for  
the differences in media thickness. The mechanism will  
automatically adjust to the required thickness of the media,  
the mechanism is normally held at a distance from the media,  
10 until the type of media is identified avoiding damage to the  
media and to the mechanism.

In another aspect of the current invention, the multi-  
media printer contains a detection means to identify the  
type of media that is inserted into the multi-media printer  
15 by the player. The detection means may include a smart card  
detection circuit, using a reader for magnetic media, using  
a radio frequency circuit for RF ID tag media, using a radio  
frequency circuit for RF fiber media, using optical scanning  
and/or thickness measurement for thermal reversible media,  
20 and using optical scanning and/or thickness measurement for  
write once media.

In another aspect of the current invention, the multi-  
media printer contains an optical scanning or interrogation  
system. The interrogation system is used to determine the  
25 cleanliness of the media and therefore its suitability for  
continued use by the multi-media printer. Media determined  
not to be suitable for continued use is considered exhausted  
media and is set aside or stored for later retrieval and  
possible refurbishment by qualified personnel.

30

35

1

## BRIEF DESCRIPTION OF THE DRAWINGS

5 These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

10 FIG. 1 is a block diagram of a cashless gaming machine and system in accordance with an exemplary embodiment of the present invention;

FIG. 2a is an illustration of a voucher in accordance with an exemplary embodiment of the present invention;

15 FIG. 2b is an illustration of another portion of a voucher in accordance with an exemplary embodiment of the present invention;

FIG. 2c is an illustration of another portion of a voucher having a static memory in accordance with an exemplary embodiment of the present invention;

20 FIGS. 3a to 3d illustrate a sequence of using a voucher having multiple printing areas in accordance with an exemplary embodiment of the present invention;

FIG. 4a is a block diagram illustrating a security feature employing capacitive inks in accordance with an exemplary embodiment of the present invention;

25 FIG. 4b is a block diagram of a security feature using randomly deposited radio sensitive fibers or inks embedded in a voucher in accordance with an exemplary embodiment of the present invention;

30 FIG. 5 is a block diagram of the operation of a multi-media printer in accordance with an exemplary embodiment of the present invention;

35 FIG. 6 is an architecture diagram of a multi-media printer employing components having integral controllers in accordance with an exemplary embodiment of the present invention;

FIG. 7a is an isometric view of a multi-media printer in accordance with an exemplary embodiment of the present invention;

1

FIG. 7b is an isometric view of a multi-media printer with the voucher magazine opened in accordance with an exemplary embodiment of the present invention;

5

FIG. 8 is side elevation view of a multi-media printer slidably coupled to a gaming machine in accordance with an exemplary embodiment of the present invention;

10

FIG. 9 is a process flow diagram of a voucher escrowing process used by a multi-media printer in accordance with an exemplary embodiment of the present invention;

FIG. 10 is a process flow diagram of a voucher handling process in accordance with an exemplary embodiment of the present invention; and

15

FIG. 11 is a process flow diagram of a voucher cleaning process in accordance with an exemplary embodiment of the present invention.

#### DETAILED DESCRIPTION

20

25

30

FIG. 1 is a block diagram of a cashless enabled gaming machine coupled to a multi-media printer in accordance with an exemplary embodiment of the present invention. A cashless gaming system includes a cashless gaming system controller 100 hosted by a system host 102 coupled (104) to one or more cashless enabled games 106. A cashless enabled game includes a game controller 108 that controls the operation of the cashless enabled game. The game controller is coupled to a multi-media printer 110. The cashless enabled game uses the multi-media printer to write voucher media such as voucher 114. The multi-media printer includes media identification and printing algorithms 113 used in conjunction with vouchers. The voucher includes the cash-out information for a player.

35

The multi-media printer may also be coupled (112) to the host system and cashless gaming controller. The voucher may be redeemed (116) in a variety of ways. The voucher may be redeemed by a human cashier or voucher reader 122 at a game table 124, or a human cashier or voucher reader 126 at a cashier's cage or kiosk 128, or by a voucher reader 118 at

1 another cashless enabled game 120. Redemption is only  
possible after the voucher passes a verification of account  
information 130 and validation using security features 132  
5 included in the voucher.

FIG. 2a is an illustration of a voucher in accordance  
with an exemplary embodiment of the present invention. The  
voucher shown is produced from commands issued by the  
cashless enabled game to the gaming printer in response to a  
10 player's request to cash-out. The voucher 114 includes  
features such as a validation number, printed in both a  
human readable form such as a character string 200 and in a  
machine-readable form such as a bar code 202, time and date  
stamps 204, cash-out amount 206, casino location information  
15 208, cashless enabled game identifier 210, and an indication  
of an expiration date 212. Included in the voucher is a  
security feature 132 that may take one or more forms.

In one voucher media in accordance with an exemplary  
embodiment of the present invention, one face of the voucher  
20 includes a layer of writable and erasable thermally  
sensitive film. The thermal film becomes opaque at one  
temperature level but becomes transparent at another  
temperature. This effect can be used to create a thermally  
rewritable voucher.

25 FIG. 2b is an illustration of another side of a voucher  
in accordance with an exemplary embodiment of the present  
invention. The voucher 114 may also include a read/write  
magnetic strip 214 for encoding of any of the information  
described above.

30 In addition, the magnetic strip may be used to transmit  
information to the multi-media printer. For example, the  
magnetic strip may encode instructions such as configuration  
flags or programming instructions used to reconfigure or  
reprogram the multi-media printer.

35 FIG. 2c is an illustration of another portion of a  
voucher having a static memory in accordance with an  
exemplary embodiment of the present invention. The voucher  
114 may also include a static memory 216 embedded in the

1 voucher so that the voucher can be used as a "smart" card  
for encoding of any of the information described above.

5 In addition, the static memory may be used to transmit  
information to the multi-media printer. For example, the  
static memory may encode instructions such as configuration  
flags or programming instructions used to reconfigure or  
reprogram the multi-media printer.

10 FIGS. 3a to 3d illustrate a sequence of using a voucher  
having multiple writable zones in accordance with an  
exemplary embodiment of the present invention. Referring  
now to FIG. 3a, a voucher having multiple writable zones 220  
is used to implement multiple rewrite features in a voucher  
using write once media. The voucher is divided into pre-  
15 determined writable zones, shown as writable zone 1 222  
through writable zone n 224. As the voucher is composed of  
a write once media, each writable zone may be written to but  
not erased.

20 Referring now to FIG. 3b, the voucher 220 is shown  
having a first writable zone 226 having permanent  
information, such as an establishment's identifier, written  
into the first writable zone. A second writable zone 228  
has a cashout value 229 or other temporary data written to  
the writable zone. The voucher may now be redeemed or  
25 otherwise used within a cashless gaming environment as  
previously described.

30 Referring now to FIG. 3c, each time the voucher 220 is  
redeemed, any information in the first rewritable zone 226  
is preserved. However, the cashout value or other  
information printed in the second rewritable is canceled out  
by printing an obscuring indicia 230 over the information in  
the second rewritable zone. The next time the voucher is  
used in a multi-media printer, a next writable zone 232 is  
detected by the multi-media printer. The next writable zone  
35 is then used by the multi-media printer to print a cash-out  
value or other information 233 as needed.

Referring now to FIG. 3d, the voucher 220 is shown with  
each writable zone filled with an obscuring indicia, as



1 illustrated by rewritable zones 228, 232, and 236. Once  
each of the rewritable zones on the voucher or filled with  
obscuring indicia, the voucher is removed from service by  
5 the multi-media printer.

FIG. 4a is a block diagram illustrating a security  
feature employing capacitive inks in accordance with an  
exemplary embodiment of the present invention. A voucher  
114 may be imprinted with metallic inks to create one or  
10 more capacitors in the voucher. The one or more capacitors  
may be used to create a security feature in the form of a  
capacitor structure 300 whose capacitance may be detected by  
a capacitance sensor 302 coupled to the voucher. As the  
card moves across the sensor (as indicated by arrow 304) the  
15 sensor senses changes in the localized capacitance of the  
card and generates (306) a security signature signal 308  
corresponding to the structure of the capacitor structure  
300 in the voucher. This security signature signal may be  
used to identify each voucher used in a cashless enabled  
20 gaming system.

FIG. 4b is a block diagram of a security feature using  
randomly deposited radio sensitive fibers or inks embedded  
in a voucher in accordance with an exemplary embodiment of  
the present invention. A voucher 114 may include a layer of  
25 randomly deposited radio sensitive fibers 500 embedded  
within the card. An excitor 502 is used to transmit short  
pulses of radio waves 504 into the layer of fibers. In  
response to the radio waves, the fibers generate a resultant  
radio frequency signal 506 that may be detected by a sensor  
30 508. If the voucher is moving (as indicated by direction  
arrow 509) as the fibers are being excited, the sensor  
receives a time varying radio frequency signal generated by  
the excited and moving fibers. In response to the time  
varying radio frequency signal, the sensor generates (510) a  
35 time varying security signature signal 512 that may be used  
to uniquely identify each voucher in a cashless gaming  
system.



1           FIG. 5 is a block diagram of the operation of a multi-media printer in accordance with an exemplary embodiment of the present invention. A multi-media printer includes a security feature reader 600 for reading a security feature  
5           embedded in a voucher 114. The type of security feature reader is dependent on the type of security features used with the voucher. The security feature reader supplies the appropriate excitation energy and sensor to generate a  
10          security signature signal as previously described.

          The multi-media printer also includes an erase head 602 for erasing a voucher prior to printing on the voucher. The erase head raises the temperature of a rewritable thermal film to the erasing temperature and any images previously  
15          written to the voucher are erased.

          The multi-media printer also includes a print head 604 for printing on the voucher. The print head raises the temperature of the thermal film on the voucher to the writing temperature and indicia are printed onto the voucher  
20          as a result.

          The multi-media printer also includes an optical scanning device 605 for reading the printed indicia on the voucher. The operation of such a device is more fully detailed in U.S. Patent Application No. 10/136,897, filed  
25          April 30, 2002, the contents of which are hereby incorporated by reference as if stated herein in full. The optical scanning device may also be used to detect a usable writable zone on a voucher having multiple writable zones  
220 (of FIG. 3a) by the multi-media printer

30          The multi-media printer also includes a magnetic strip read/write head 607 for reading from, and writing to a magnetic strip 214 (of FIG. 2b) on the voucher.

          The multi-media printer includes a printer controller 606 operably coupled to the security feature reader. The security feature reader generates a security signature  
35          signal 608 that is transmitted to the printer controller.

          The printer controller is also coupled to the erase head. The printer controller generates an erase control

1        signal 612 that is transmitted to the erase head. In  
response to the erase head signal, the erase head heats the  
voucher until all indicia are erased from the voucher.

5        The printer controller is also coupled to the print  
head. The printer controller transmits print head control  
signals 616 to the print head. In response to the print  
head control signals, the print head heats a thermal element  
for each dot that is to be imaged on the voucher.

10       The printer controller is also coupled to the optical  
scanner 605. As the optical scanner scans the printed  
indicia on the voucher, the optical scanner transmits  
scanned signals 617 to the printer controller.

15       The printer controller is also coupled to the magnetic  
strip read/write head 607. The printer controller transmits  
magnetic strip write signals and receives magnetic strip  
read signals to and from (619) the magnetic strip read/write  
head.

20       The printer controller may also be coupled to a static  
memory read/write connector 622. The printer controller  
transmits static memory write signals and receives static  
memory read signals to and from (624) the static memory  
read/write head.

25       The printer controller may also be coupled to a media  
thickness sensor 630 for measuring the thickness of a  
voucher inserted into the multi-media printer. The  
thickness sensor may be a contact device such as a limit  
switch with multiple trip points or a potentiometer having a  
lever contacting the voucher, or may employ non-contacting  
30       optical, acoustic, or capacitance measurement techniques.  
The media thickness sensor generates media thickness signals  
632 that are transmitted back to the printer controller.

35       In one embodiment of a multi-media printer in  
accordance with the present invention, a game controller 108  
is operably coupled to the printer controller. The printer  
controller receives printer control instructions 614,  
including voucher information for writing to the voucher,  
from the game controller. The printer controller may also

1 transmit printer status and voucher identification signals  
610 to the game controller.

5 FIG. 6 is a block diagram of a multi-media printer in  
accordance with an exemplary embodiment of the present  
invention. A multi-media printer 110 includes a printer  
controller 606, a print module 702, and one or more voucher  
magazines 704.

10 The print module includes a print voucher drive 706  
that moves vouchers through the print module. The print  
voucher drive is reversible such that a voucher may be fed  
through the print module in more than one direction by the  
print voucher drive. The print voucher drive includes a  
15 voucher motion sensor 707 for sensing voucher movement  
within the print voucher drive. A more detailed discussion  
of printer media motion detection within a printer is  
presented in U.S. Patent Application entitled "PAPER MOTION  
DETECTOR IN A GAMING MACHINE", attorney docket number  
20 50820/FLC/F392 filed August 12, 2003, the contents of which  
are hereby incorporated by reference as if stated herein in  
full. The print drive further includes an embossing  
detector 709 that may be used to sense when an embossed  
item, such as a conventional credit voucher, is inserted  
into the print module. The embossing detector may be a  
25 mechanical device, such as a limit switch, that contacts an  
inserted card and detects any embossing. If an embossed  
card is inserted into the multi-media printer, the multi-  
media printer may not attempt to write to the card, only  
read the card.

30 The print module further includes a security feature  
reading device 600 for reading any security features  
included in the voucher. The print module further includes  
a print head 604 for writing indicia to the voucher and an  
erase head 602 for erasing the indicia from the voucher.  
35 The print module. The print module further includes an  
optical scanning device 605 for scanning the indicia printed  
onto a voucher. The print module further includes a  
magnetic strip read/write head 607 used to read and write

1 from and to a voucher's magnetic strip. The print module is  
removably and electronically coupled to the printer  
controller and removably and mechanically coupled to the  
5 voucher magazine.

In operation, the print module receives printer control  
signals from the printer controller. In response to the  
printer control signals, the print module scans vouchers for  
the presence and value of any security feature in the  
10 voucher. As the print module scans the voucher, the  
security feature reading device generates a previously  
described security signature signal that is transmitted to  
the printer controller. In addition, the print module  
thermally prints on the vouchers, and thermally erases the  
15 vouchers, under the control of the printer controller. The  
print module may also receive a voucher from a player and  
transmit a voucher detection signal to the printer  
controller.

The print module may also include a static memory  
20 read/write connector 622 for coupling to a "smart" card  
having a readable/writable static memory. The printer  
controller transmits static memory write signals and  
receives static memory read signals to and from the static  
memory read/write head.

25 The one or more independently controlled voucher  
magazines store vouchers and provide the vouchers to the  
printer module on command from the printer controller. Each  
voucher magazine may include one or more magazine voucher  
drives 710 for moving vouchers into and out of the magazine.  
30 If voucher magazine has only one voucher drive, the voucher  
magazine may be used for Last In, First Out (LIFO) type  
voucher media storage and retrieval operations. If the  
voucher magazine includes two or more voucher drives, the  
voucher magazine may be used for First In, First Out (FIFO)  
35 type storage and retrieval operations. Each voucher  
magazine also includes a voucher storage area 712 for  
storage of vouchers. In operation, the voucher magazine  
receives voucher magazine control signals from the printer

1 controller. In response to the control signals, the voucher  
magazine feeds vouchers to the printer from the voucher  
storage area using the magazine voucher drive. In response  
5 to the voucher magazine control signals, the voucher  
magazine may also receive vouchers from the print module and  
store the vouchers in the voucher storage area. The voucher  
magazine may also include one or more voucher sensors 714  
used to detect the number of vouchers stored in the voucher  
10 storage area. The voucher sensors sense the quantity of  
vouchers stored in the voucher storage area and transmit  
voucher count signals to the printer controller for further  
processing. The voucher magazine may also include a  
read/write static memory 715 for semi-permanent storage of  
15 voucher information about vouchers stored in the voucher  
magazine.

The printer controller includes a processor 716 coupled  
to a main memory 718 by a system bus 720. The printer  
controller also includes a storage memory 722 coupled to the  
20 processor by the bus. The storage memory stores programming  
instructions 113, executable by the processor to implement  
the features of a multi-media printer. The storage memory  
also includes printer and voucher information 724 stored and  
used by the processor. The printer and voucher information  
25 includes information received by the printer controller  
about the status of the print module and voucher magazine  
and also about the status and identity of any vouchers  
stored in the voucher magazines or being operated on by the  
print module. The types of status information may include  
30 an image of a last printed voucher as scanned by the optical  
scanning device and the current status, such as millimeters  
of advancement, of a voucher currently in the print module.

The printer controller also includes an Input/Output  
(I/O) device 726 coupled to the processor by the system bus.  
35 The I/O device is used by the printer controller to transmit  
control signals to the print module and the voucher  
magazine. The I/O device may also be used by the printer

1 controller to receive security feature and status signals  
from the print module and voucher magazine.

5 One or more communications devices 728 may be coupled  
to the system bus for use by the printer controller to  
communicate with a cashless gaming system host 102 or a game  
controller 108 (both of FIG. 1). The printer controller  
uses the communication devices to receive commands, program  
10 instructions, and voucher information from the external  
devices. In addition, the printer controller may use the  
communication devices to transmit printer status information  
to the external devices. Other communication devices may  
also be used by the printer controller to couple in a secure  
fashion over a local area network 732 for administrative or  
15 other purposes.

Additional communication devices and channels may be  
provided for communication with other peripheral devices as  
needed. For example, one communication device may be  
provided with a local communications port, accessible from  
20 an exterior of a gaming machine hosting the multi-media  
printer, that a technician may use to communicate with the  
printer controller during servicing using an external  
controller 730. The external controller may communicate  
with the printer controller using an infrared link, other  
25 short-range wireless communication link, or a hard link  
with an external connector in a secure manner.

In operation, the processor loads the programming  
instructions into the main memory and executes the  
programming instructions to implement the features of a  
30 multi-media printer as described herein.

As illustrated, the printer controller is shown as  
being electronically coupled to the print module and voucher  
magazine without any mechanically coupling. The printer  
controller may be mounted in a variety of ways and may be  
35 incorporated into various components of either the multi-  
media printer or the game hosting the multi-media printer.  
For example, the printer controller may be attached to and  
supported by the print module, the voucher magazine, or the



1 host game as may be required to mechanically integrate the multi-media printer into the host game.

5 In one embodiment of a multi-media printer in accordance with an exemplary embodiment of the present invention, the multi-media printer does not have a modular architecture. Instead, the print module and voucher magazine are of unitary construction.

10 FIG. 7a is an isometric view of a multi-media printer in accordance with an exemplary embodiment of the present invention. As illustrated, the multi-media printer 110 includes a print module 702 and one or more voucher magazines 704 mechanically coupled on a base 800. The multi-media printer includes a front bezel 802 through which  
15 a voucher 114 may be fed by the print module's print voucher drive 706, either into or out of the multi-media printer as previously described. The voucher magazine is positioned on the base such that the voucher magazine's magazine voucher drive 710 may feed vouchers to and receive vouchers from the  
20 print module as previously described. The print module and the magazine drive are separately mounted to the base and each may separately serviced in the field without affecting the operation of the other. In addition, each component may be removed from the multi-media printer and replaced without  
25 removing the power to the multi-media printer.

The print module further includes an articulating print head mounting mechanism 803. The mechanism is used to adjust for differences in voucher media thickness. The mechanism automatically adjusts the print head to a required  
30 height dictated by the thickness of the media. When a voucher is inserted into the print module by a user, the mechanism is held at a distance from the media by the printer controller 606 (of FIG. 5) until the type of media is identified. This avoids damaging the voucher media and  
35 the print head mounting mechanism by avoiding contact between the print head and the media. Once the media type is determined, the printer controller allows the mechanism



1 to position the print head onto the voucher media if  
printing is required.

5 As the print module and voucher magazine are separately  
mounted and controllable, the orientation of the print  
module and voucher magazine may be altered as needed to suit  
the mechanical requirements of a host game. For example the  
distance between the print module and the voucher magazine  
may be altered in order to accommodate a shorter printer bay  
10 included in a host game.

FIG. 7b is an isometric view of a multi-media printer  
with the voucher magazine opened in accordance with an  
exemplary embodiment of the present invention. As  
illustrated, the multi-media printer 110 includes a print  
15 module 702 and one or more voucher magazines 704  
mechanically coupled on a base 800. The multi-media printer  
includes a front bezel 802 through which a voucher 114 may  
be fed by the print module's print voucher drive 706, either  
into or out of the multi-media printer, as previously  
described. The voucher magazine is positioned on the base  
20 such that the voucher magazine's magazine voucher drive 710  
may feed vouchers to and receive vouchers from the print  
module as previously described. The magazine voucher drive  
is removably coupled to the voucher storage area 712 by a  
25 hinge 900 such that the magazine may be opened to allow  
access to the voucher storage area.

A cleaning device 902 (shown through a cutaway in the  
front bezel 802) is attached to the print module such that  
incoming vouchers are cleaned before they enter the print  
30 module. The cleaning device may include flexible solid or  
bristled wiper elements that contact the voucher as it is  
taken into the print module. The wiper elements may be  
conductive so as to remove static surface charges from the  
voucher as it moves in the multi-media printer. The wiper  
35 elements may also be charged so as to electrically attract  
and collect particles of dust and dirt from the voucher. As  
the print module's print voucher drive is reversible, the

1 incoming voucher may be passed repeatedly, back and forth,  
through the cleaning element as needed.

5 In other print modules in accordance with other  
exemplary embodiments of the present invention, the cleaning  
device may be located within the print module, within the  
voucher magazine, or between the print module and a voucher  
magazine. In other multi-media printers in accordance with  
10 exemplary embodiments of the present invention, the cleaning  
device is a separate device and not integrated with either a  
print module or a voucher magazine. Instead, the cleaning  
device is a separate motorized device similar to a voucher  
magazine and is electronically coupled to a printer  
controller.

15 In another multi-media printer in accordance with an  
exemplary embodiment of the present invention, the multi-  
media printer contains a cleaning system used to clean the  
print head and thermal reversible, smart card, or write once  
media. The cleaning system may be internal to the multi-  
20 media printer or may be a removable cartridge that can be  
placed in the multi-media printer for cleaning then removed  
after cleaning is complete.

In one multi-media printer in accordance with an  
exemplary embodiment of the present invention, blank voucher  
25 media is stored as a continuous strip of fanfold or ribbon  
material and is cut to length by the multi-media printer as  
needed. The material may include perforations at  
predetermined locations so that the voucher size may be  
controlled independently of the multi-media printer.

30 FIG. 8 is side elevation view of a multi-media printer  
slidably coupled to a gaming machine in accordance with an  
exemplary embodiment of the present invention. The multi-  
media printer 110 includes a print module 702 and a voucher  
magazine 704 mechanically coupled to a printer base 1150.  
35 The multi-media printer includes a front bezel 802 through  
which a rewritable card may be fed by the print module's  
print voucher drive 706, either into or out of the multi-  
media printer as previously described. Voucher magazine 704

1 is positioned on the base such that the voucher magazine's  
magazine voucher drive 710 may feed vouchers 114 to and  
5 receive vouchers from the print module as previously  
described.

10 The printer base is further slidably coupled to a base  
plate 1152 that is fixedly coupled to a portion 1154 of a  
gaming machine hosting the printer. The multi-media printer  
may be accessed while still in the gaming machine by sliding  
the multi-media printer out of the gaming machine. The  
voucher magazine may be mechanically coupled to the printer  
base by a quick disconnect 1156 so that the voucher magazine  
may be easily removed. To facilitate easy removal, the  
15 voucher magazine may be coupled to the printer controller  
606 (of FIG. 5) by a quick disconnect electrical connector  
1157 that allows the voucher magazine to be installed,  
removed, or exchanged without removing the power to the  
gaming machine or multi-media printer.

20 The print module may be mechanically coupled to the  
printer base by a quick disconnect 1158 so that the print  
module may be easily removed. To further facilitate easy  
removal, the print magazine may be coupled to the printer  
controller 606 (of FIG. 5) by a quick disconnect electrical  
connector 1160 that allows the print module to be installed,  
25 removed, or exchanged without removing the power to the  
gaming machine or multi-media printer.

30 In one embodiment of a voucher magazine, the voucher  
magazine is slidably coupled to the printer base separately  
from the print module. In this embodiment, the voucher  
magazine may accessed by sliding the voucher magazine past  
the print module so that the voucher magazine may be  
separately serviced.

35 FIG. 9 is a process flow diagram of a voucher escrowing  
process used by a multi-media printer in accordance with an  
exemplary embodiment of the present invention. In a voucher  
escrowing process 1300, a multi-media printer determines if  
a voucher should be removed from service. A voucher may be  
removed from service for a variety of reasons. Rewritable

1 vouchers may have a finite number of erase and write cycles  
and so must be removed from service as they age. A voucher  
may become damaged so that it is no longer operable within  
5 multi-media printer or a voucher using write once media may  
be completely filled. A card may also have physical  
features such as embossing that may require the voucher to  
be handled in a special manner. As the multi-media printer  
includes an optical scanner and can verify if a voucher was  
10 printed properly immediately after printing the voucher, the  
multi-media printer may determine that a voucher was printed  
in error and may escrow the voucher. In addition, the  
multi-media printer may receive an identifier for a voucher  
to be removed from service. In which case, the security  
15 feature in the voucher may be readable but correspond to a  
voucher to be removed from service. Another reason a  
voucher may be escrowed is that the user is exchanging one  
kind of voucher for another kind of voucher.

Vouchers may be removed from service by moving the  
20 voucher into an escrow location within the multi-media  
printer by either a magazine voucher drive or by a print  
voucher drive. In the escrow process, the voucher  
determines (1302) if a voucher should be removed from  
service. If the multi-media printer determines that the  
25 voucher should remain in service (1304), the voucher  
continues processing (1306) the voucher. Otherwise, the  
multi-media printer moves (1306) the voucher to an escrow  
location 1307 within the multi-media printer and obtains  
(1308) a replacement voucher from a voucher magazine 1310  
30 and continues processing (1312) the newly obtained voucher.

FIG. 10 is a process flow diagram of a voucher handling  
process in accordance with an exemplary embodiment of the  
present invention. A voucher handling process 1000 is used  
by a multi-media printer to manage a voucher that is  
35 inserted into the multi-media printer. To initiate a  
voucher handling process, a player inserts (1001) a voucher  
or card into the multi-media printer. The multi-media  
printer raises (1002) the thermal print head 604 (of FIG. 5)

1 up so as not to damage the inserted voucher or card while  
the multi-media printer determines the type of the inserted  
media.

5 The multi-media printer determines (1004) if the  
inserted media is an ATM type credit card using a sensor  
such as an embossing detector 709 (of FIG. 6). If the  
inserted media is not an ATM type card, the multi-media  
10 printer determines (1006) if the inserted media is a smart  
card by trying to read data from the inserted media using  
the static memory read/write connector 622 (of FIG. 5). If  
the inserted media is not a smart card, the multi-media  
printer determines (1008) if the inserted media includes a  
15 magnetic strip by trying to read data from the inserted  
media using the magnetic strip read/write head 607 (of FIG.  
5). If the inserted media does not include a magnetic  
strip, the multi-media printer determines (1010) if the  
inserted media is thermally rewritable by using the media  
20 thickness sensor 630 (of FIG. 5). If the inserted media is  
not thermally rewritable, the multi-media printer determines  
(1012) if the inserted media is write once media by using  
the media thickness sensor. If the multi-media printer  
cannot determine the type of the inserted media, then the  
multi-media printer ejects (1014) the card and continues  
25 processing (1036) any additional cards presented by a user.

If the multi-media printer can identify the media type  
of the inserted voucher or card, the multi-media printer  
reads voucher information stored on the voucher. The multi-  
media printer transmits the voucher information to a gaming  
30 machine 106 or a host system 102 (both of FIG. 1) for  
authentication (1016). If the results of the authentication  
indicate that the voucher or card is invalid (1018), then  
the voucher or card is ejected 1020 and the multi-media  
printer terminates processing of the card.

35 If the multi-media printer determines (1022) the  
inserted media is thermally reversible, the multi-media  
printer adjusts (1024) the thermal erase and print heads for  
continuing (1036) operations on the inserted voucher or card

1 as may be required. The operations may include erasing the  
inserted voucher or card and storing the erased card in a  
LIFO or FIFO voucher magazine.

5 If the multi-media printer determines (1024) the  
inserted media includes a magnetic strip, the multi-media  
printer holds (1026) the inserted voucher or card for  
continuing (1036) operations as may be required. The  
operations may include erasing the inserted voucher or card  
10 and storing the erased card in a LIFO or FIFO voucher  
magazine for later use.

If the multi-media printer determines (1028) the  
inserted media is an ATM style credit card, the multi-media  
printer holds (1030) the inserted voucher or card for  
continuing (1036) operations as may be required. The  
15 operations may include reading the inserted voucher or card  
for further processing.

If the multi-media printer determines (1032) the  
inserted media is write once thermal media, the multi-media  
20 printer adjusts (1034) the thermal erase and print heads for  
continuing (1036) operations on the inserted voucher or card  
as may be required. The operations may include overwriting  
a last written writable zone, such as writable zone 228 (of  
FIG. 3c) on an inserted voucher or card and storing the  
25 overwritten card in a LIFO or FIFO voucher magazine for  
later use.

FIG. 11 is a process flow diagram of a voucher media  
cleaning process in accordance with an exemplary embodiment  
of the present invention. A multi-media printer uses a  
30 voucher media cleaning process 1500 to determine the  
cleanliness of a voucher or card and to clean the voucher or  
card before using the voucher or card. The multi-media  
printer determines (step 1004 to step 1012 of FIG. 10), if  
the voucher or card is composed of a media that may be  
35 cleaned, such as a rewritable thermal media. If so, the  
multi-media performs a cleanliness test (1502) on the  
voucher or card. A cleanliness test may be performed using  
the optical scanning device 605 (of FIG. 5) by measuring the



1 optical characteristics of non-printed printed portions of  
the voucher or card.

5 If the multi-media printer determines that the card is  
clean (1504) the multi-media printer continues (1506)  
processing the voucher or card as required. If the voucher  
or card is not clean, the multi-media printer determines  
(1508) if a cleaning device 902 (of FIG. 8) is installed in  
the multi-media printer. If not, the multi-media printer  
10 stores (1518) the voucher or card to remove the unusable  
media from service. If the cleaner is installed, the multi-  
media printer cleans (1510) the voucher or card as  
previously described. The multi-media printer then performs  
(1512) another cleanliness test as previously described.  
15 The multi-media printer then determines (1514) if the second  
cleanliness test indicates that the voucher or card was  
successfully cleaned. If so, the multi-media printer  
continues (1516) processing the voucher or card as required.  
If not, the multi-media printer stores (1518) the voucher or  
20 card to remove the unusable media from service.

Although this invention has been described in certain  
specific embodiments, many additional modifications and  
variations would be apparent to those skilled in the art.  
It is therefore to be understood that this invention may be  
25 practiced otherwise than as specifically described. Thus,  
the present embodiments of the invention should be  
considered in all respects as illustrative and not  
restrictive, the scope of the invention to be determined by  
any claims supported by this application and the claims'  
30 equivalents rather than the foregoing description.

35



1

WHAT IS CLAIMED IS:

1. A multi-media gaming printer comprising:
  - 5 a print module comprising a thermal head;  
an additional head selected from the group including an optical head, a magnetic strip head, a capacitance head, and a smart card connector; and
  - 10 a controller coupled to the thermal head and the additional head.
2. The multi-media gaming printer of Claim 1, the print module further comprising an articulated media drive coupled to the controller, the articulated card drive adjustable to  
15 accommodate media with various thicknesses.
3. The multi-media gaming printer of Claim 1, further comprising a media magazine coupled to the controller and operable to receive and transmit media from and to the print  
20 module.
4. The multi-media gaming printer of Claim 3, the media magazine further comprising a media quantity sensor.
- 25 5. The multi-media gaming printer of Claim 3, the media magazine further comprising a read/write media information memory.
6. The multi-media gaming printer of Claim 1, further  
30 comprising a media cleaner.
7. The multi-media gaming printer of Claim 1, further comprising a media cleanliness interrogator.
- 35 8. The multi-media gaming printer of Claim 1, further comprising a media motion sensor.

- 1 9. The multi-media gaming printer of Claim 1, further comprising an embossing sensor.
- 5 10. The multi-media gaming printer of Claim 1, further comprising an external communication port.
11. A method of operating a multi-media gaming printer comprising:
- 10 receiving by the multi-media gaming printer a card;
- determining by the multi-media gaming printer if the card should be placed in escrow; and
- moving by the multi-media gaming printer the card into an escrow location if the card should be placed in escrow.
- 15
12. The method of operating a multi-media gaming printer of Claim 11, wherein determining if the card should be placed in escrow further comprises:
- 20 determining the type of the card;
- attempting to perform a read operation on the card, the read operation according to the type of the card; and
- 25 determining that the card should be escrowed if the read operation fails.
13. The method of operating a multi-media gaming printer of Claim 11, wherein:
- 30 the multi-media gaming printer comprises a media storage device; and
- moving by the multi-media gaming printer the card into an escrow location further comprises moving the card into the media storage device.
- 35
14. The method of operating a multi-media gaming printer of Claim 11, wherein the multi-media gaming printer comprises a media storage device, the method further comprising

1 replacing an escrowed card with a viable card from the media storage device.

5 15. The method of operating a multi-media gaming printer of Claim 11, wherein moving the card into an escrow location further comprises:

10 determining the type of the card; and  
erasing the card according to the type of the card.

16. The method of operating a multi-media gaming printer of Claim 11, wherein determining if the card should be placed in escrow further comprises:

15 performing the following if the multi-media gaming printer determines that the card comprises write once media:

determining the number of times the card has been written to; and  
20 determining that the card should be placed into escrow if the number of times the card has been written to exceeds a threshold value.

17. A method of operating a multi-media gaming printer comprising:

25 receiving a card by the multi-media gaming printer;

determining by the multi-media gaming printer if the card should be cleaned; and

30 cleaning the card by the multi-media gaming printer if the card should be cleaned.

18. The method of operating a multi-media gaming printer of Claim 17, wherein determining if the card should be cleaned further comprises scanning the card optically to detect  
35 optical read failures.

1 19. The method of operating a multi-media gaming printer of  
Claim 17, wherein cleaning the card further comprises  
5 passing the card one or more times through a cleaning device  
by the multi-media gaming printer.

20. The method of operating a multi-media gaming printer of  
Claim 17, further comprising replacing the card with a  
viable card if cleaning the card fails.

10 21. A multi-media gaming printer comprising:  
a print module for manipulating cards comprising  
different types of media, the print module comprising:  
a first head for manipulating a first type of  
15 card;  
a second head for manipulating a second type  
of card, the first type of card and the second  
type of card being different types; and  
a controller for controlling the print module.

20 22. The multi-media gaming printer of Claim 21, further  
comprising an articulated media drive for accommodating  
media with various thicknesses.

25 23. The multi-media gaming printer of Claim 21, further  
comprising a media magazine for storage of media and for  
receiving and transmitting media from and to the print  
module.

30 24. The multi-media gaming printer of Claim 23, the media  
magazine further comprising a sensor for sending a quantity  
of media stored in the media magazine.

35 25. The multi-media gaming printer of Claim 23, the media  
magazine further comprising a memory for storage of  
information about media stored in the media magazine.

1

26. The multi-media gaming printer of Claim 21, further comprising a cleaner for cleaning media inserted into the gaming multi-media printer.

5

27. The multi-media gaming printer of Claim 21, further comprising a sensor for determining the cleanliness of media inserted into the gaming multi-media printer.

10

28. The multi-media gaming printer of Claim 21, further comprising a sensor for detecting the motion of media within the multi-media gaming printer.

15

29. The multi-media gaming printer of Claim 21, further comprising a sensor for sensing embossing on a card inserted into the multi-media gaming printer.

20

30. The multi-media gaming printer of Claim 21, further comprising an external port for communicating with an external device.

25

30

35

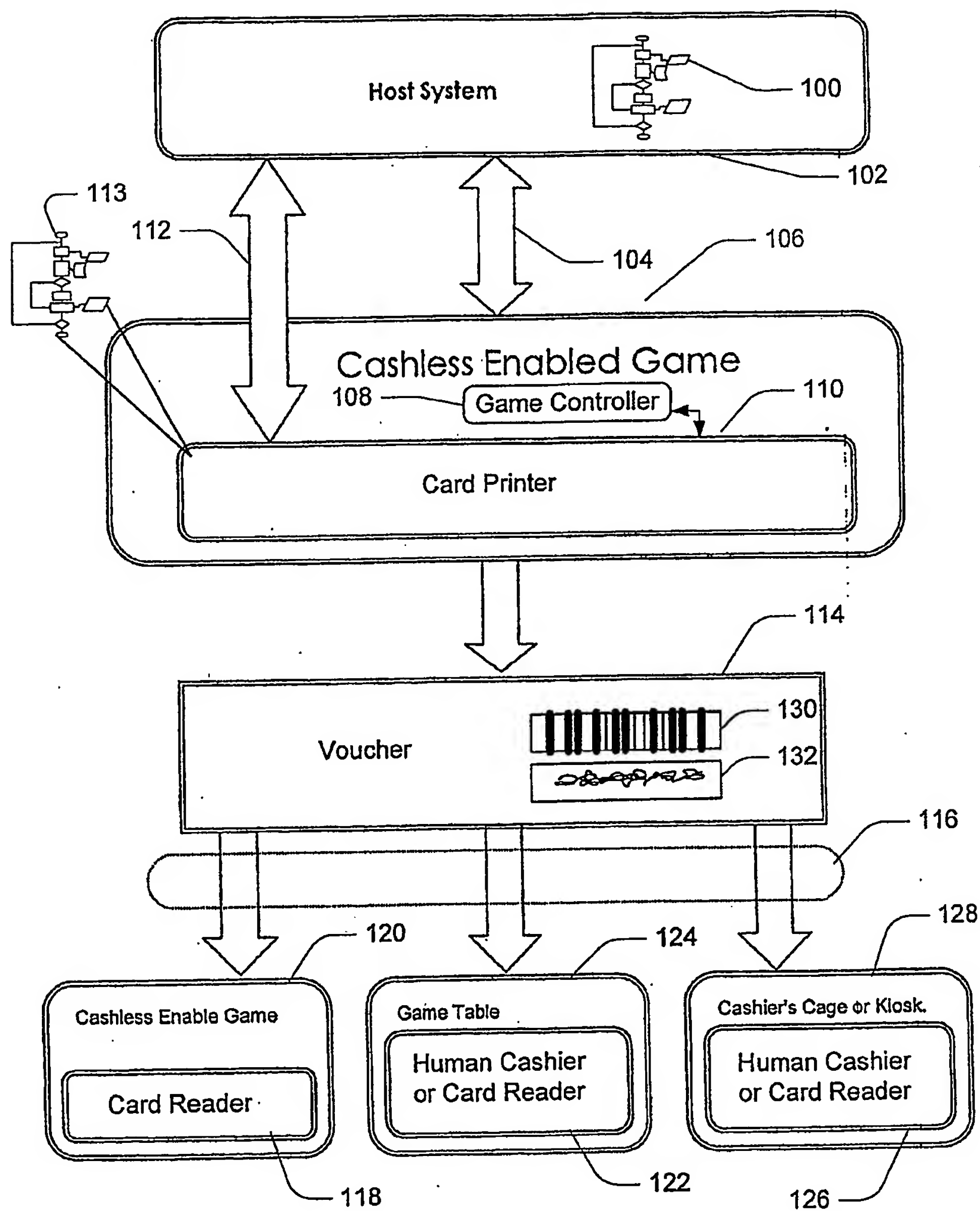


FIG. 1



FIG. 2a

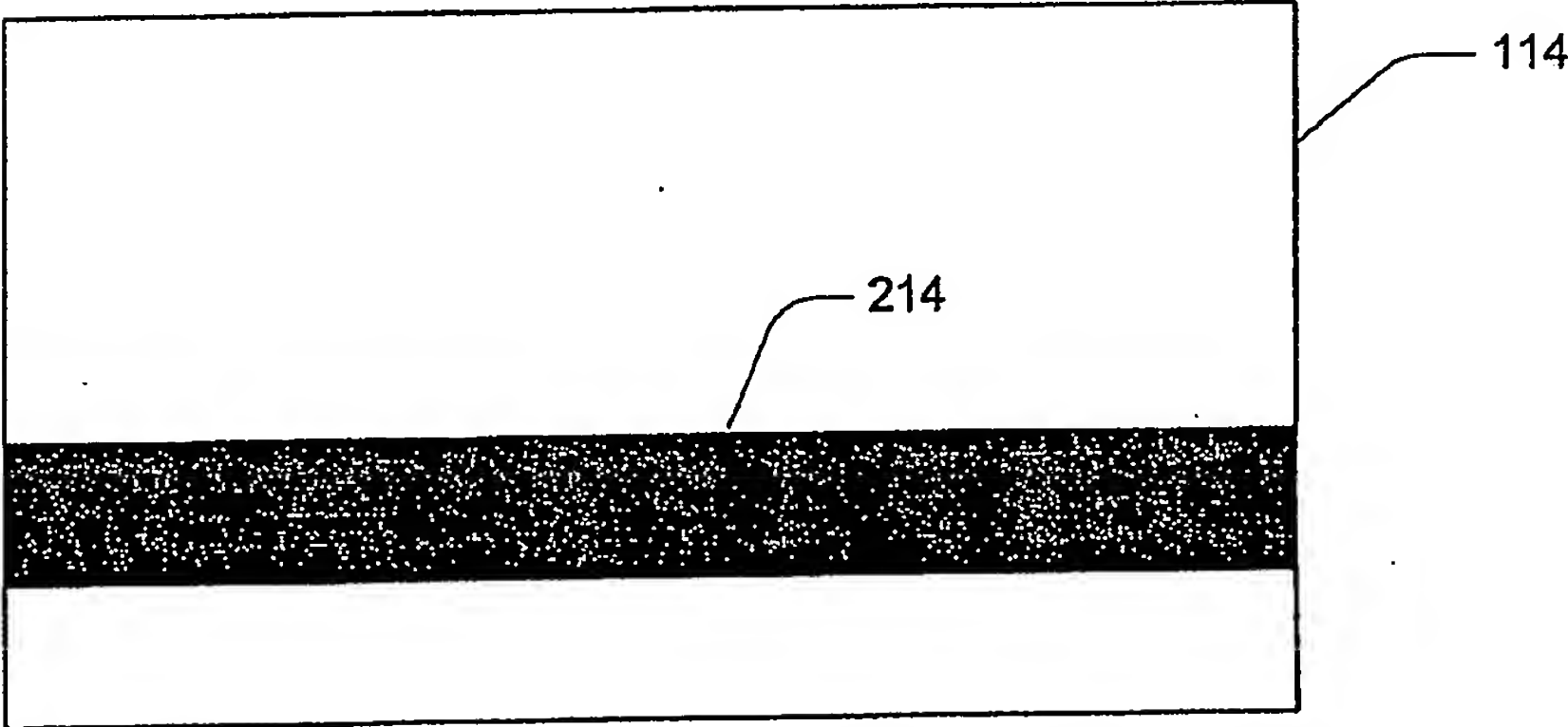


FIG. 2b

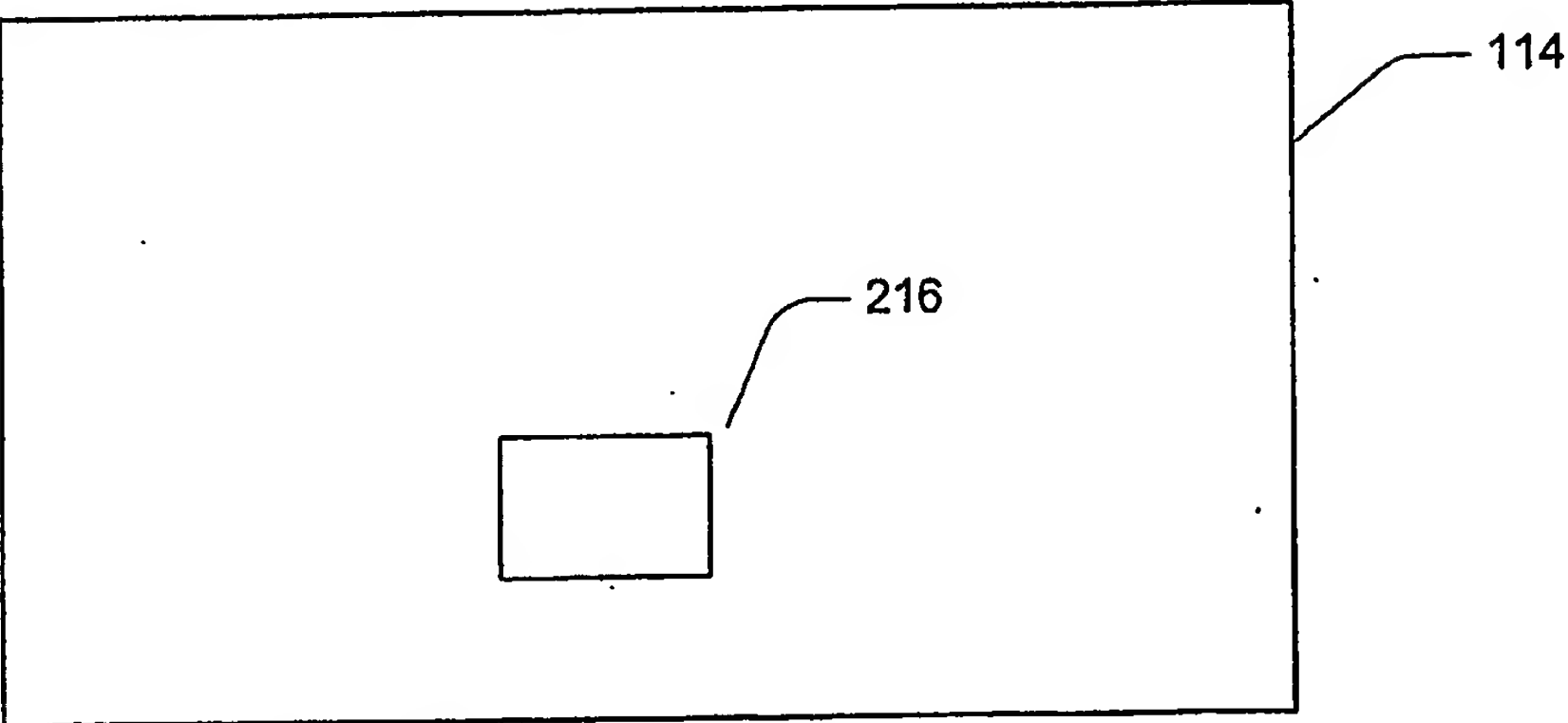


FIG. 2c

BEST AVAILABLE COPY



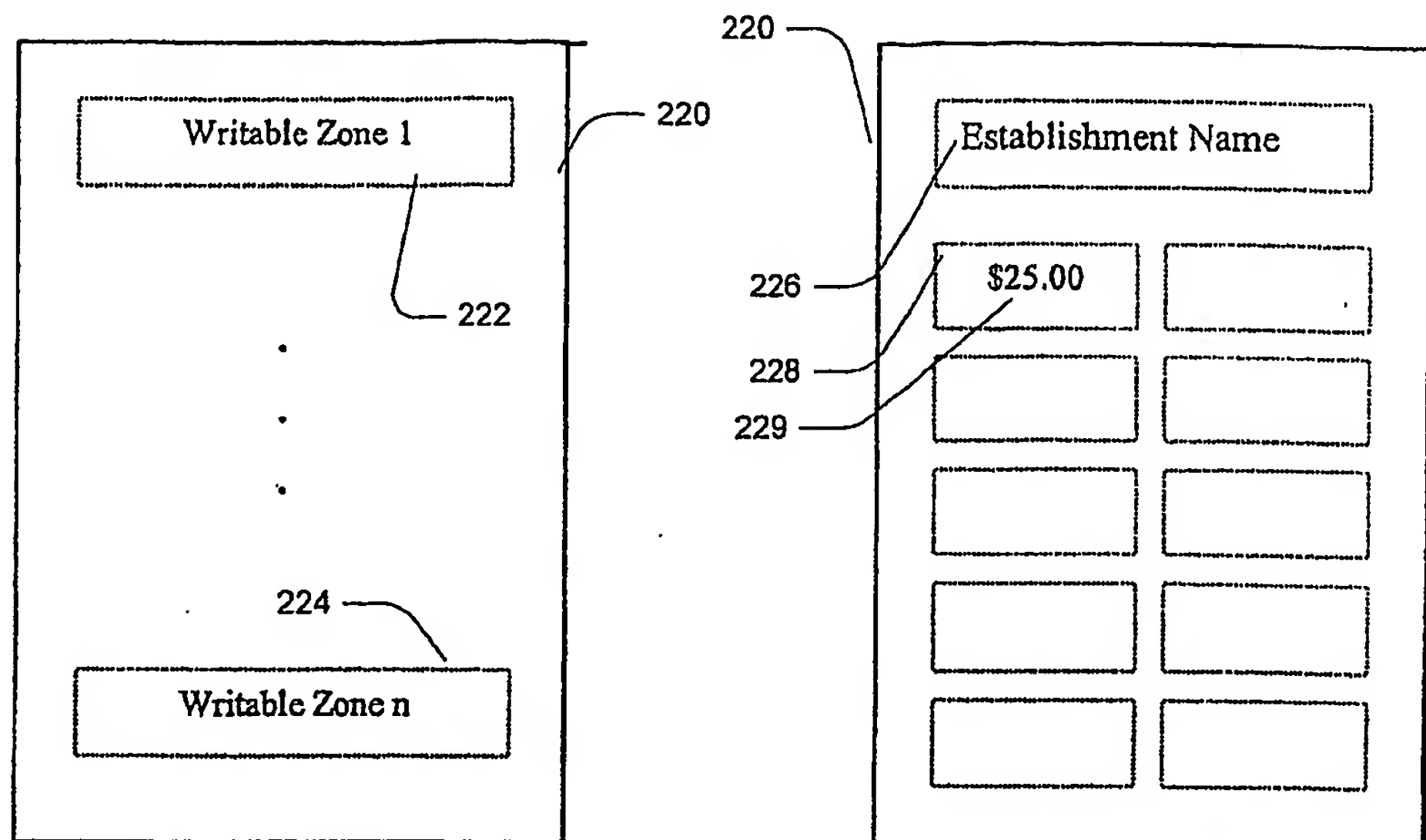


FIG. 3a

FIG. 3b

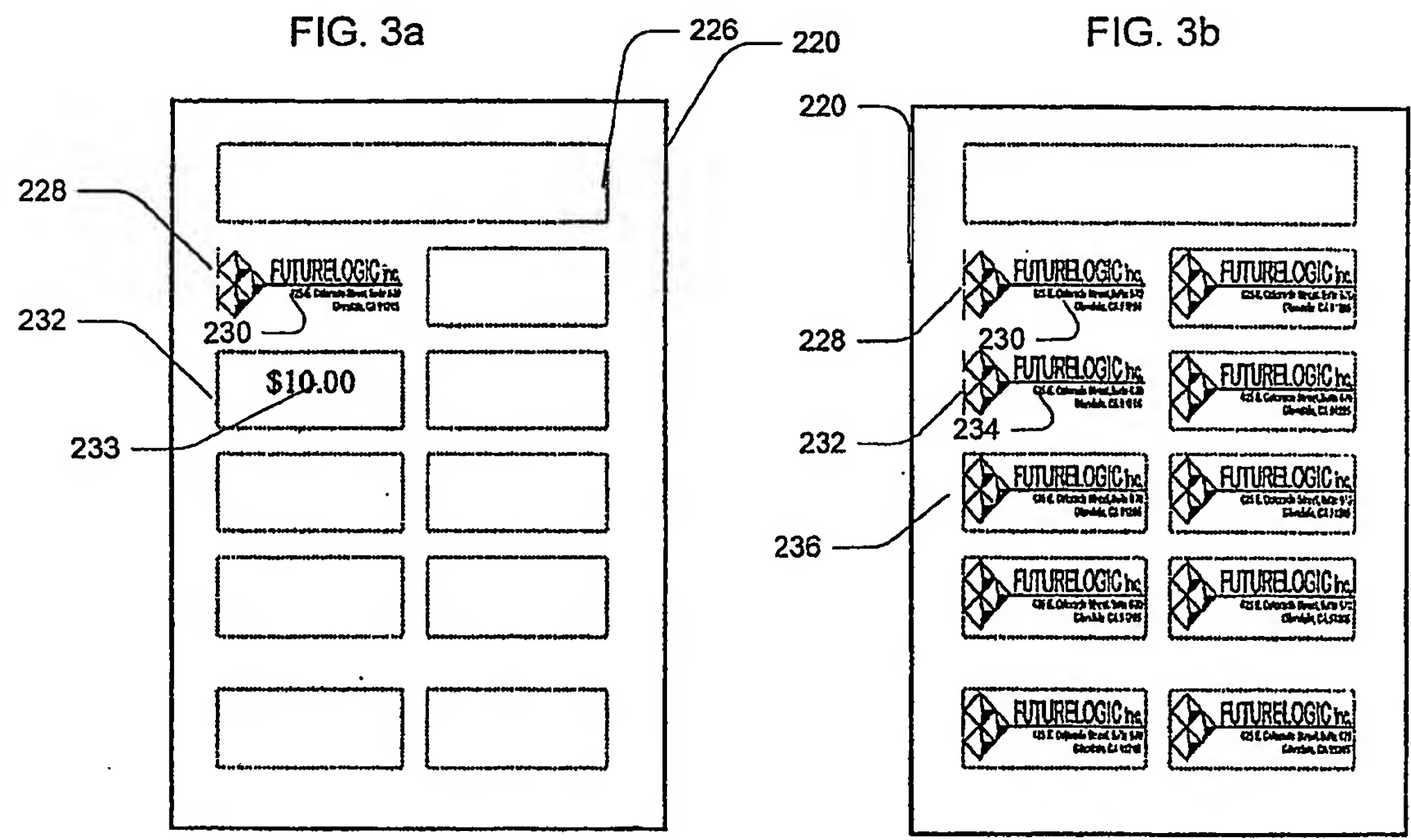
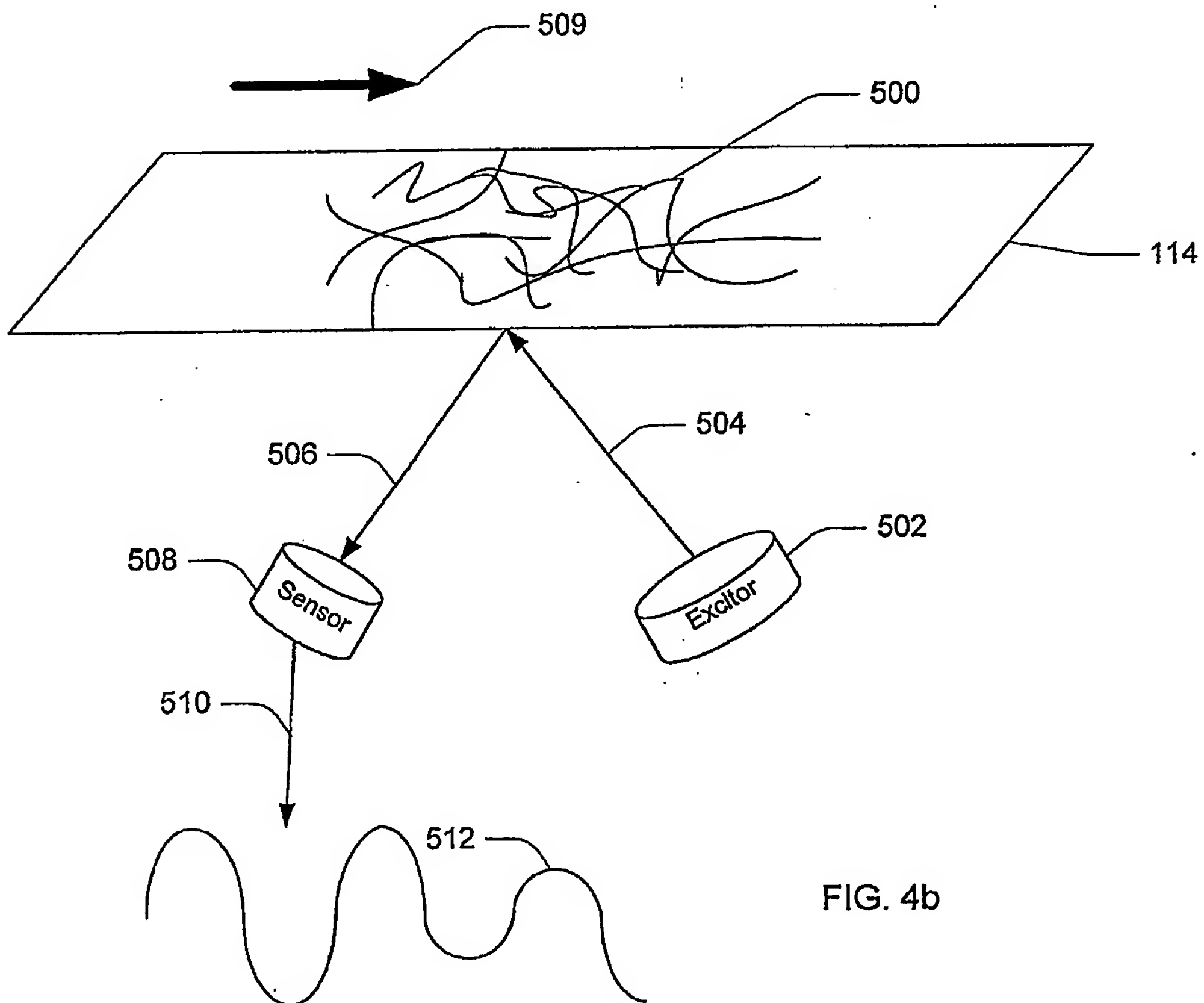
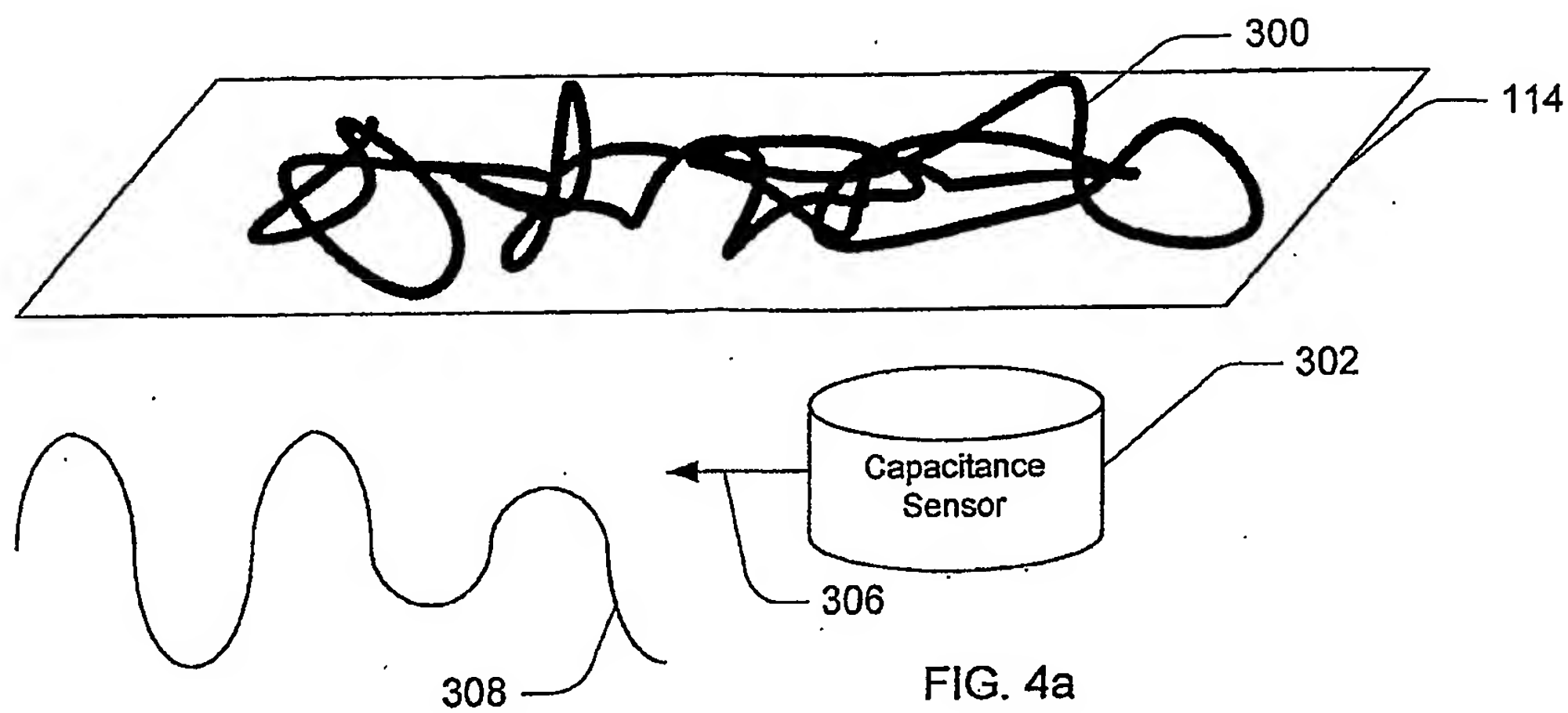


FIG. 3c

FIG. 3d

BEST AVAILABLE COPY



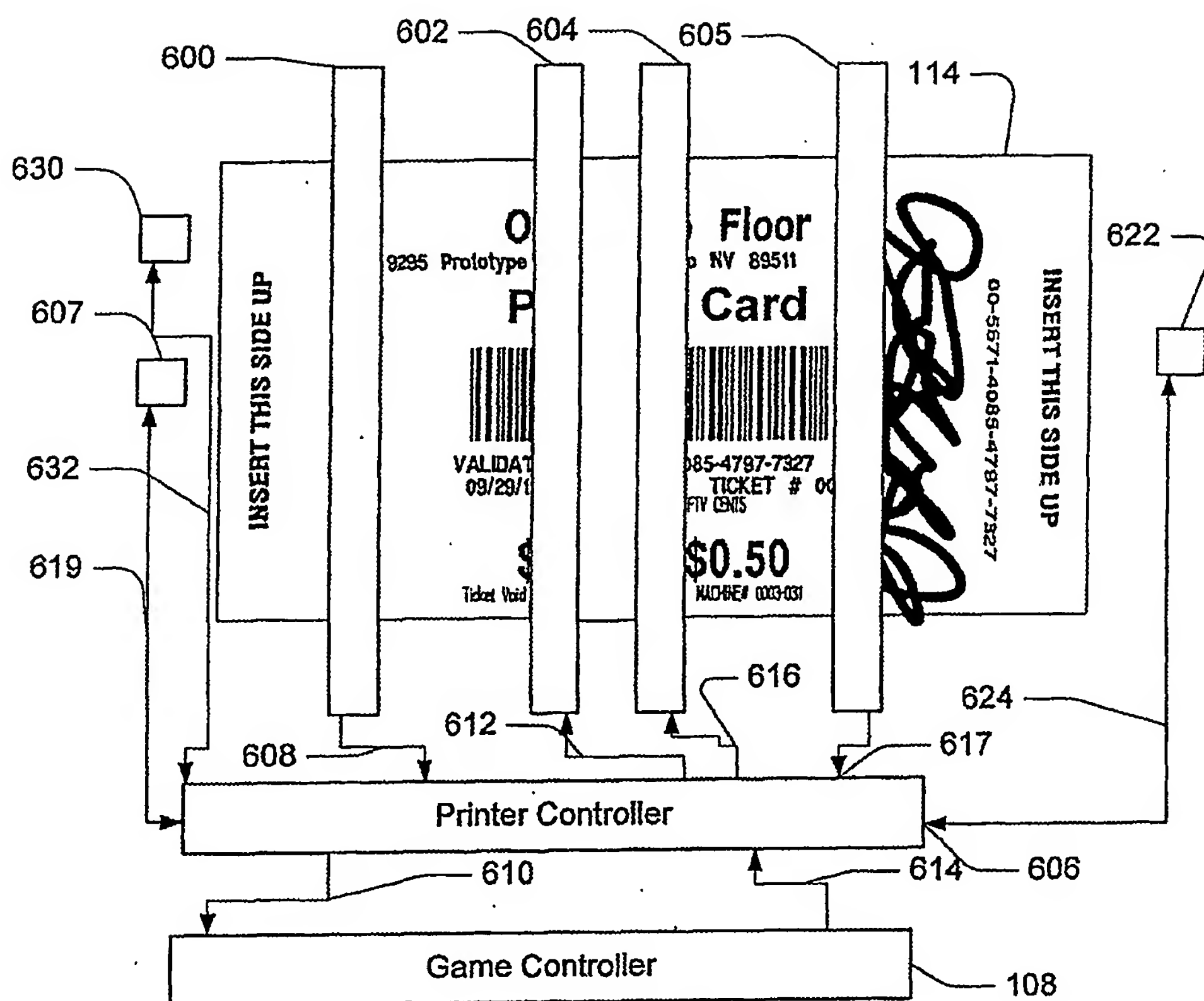


FIG. 5.

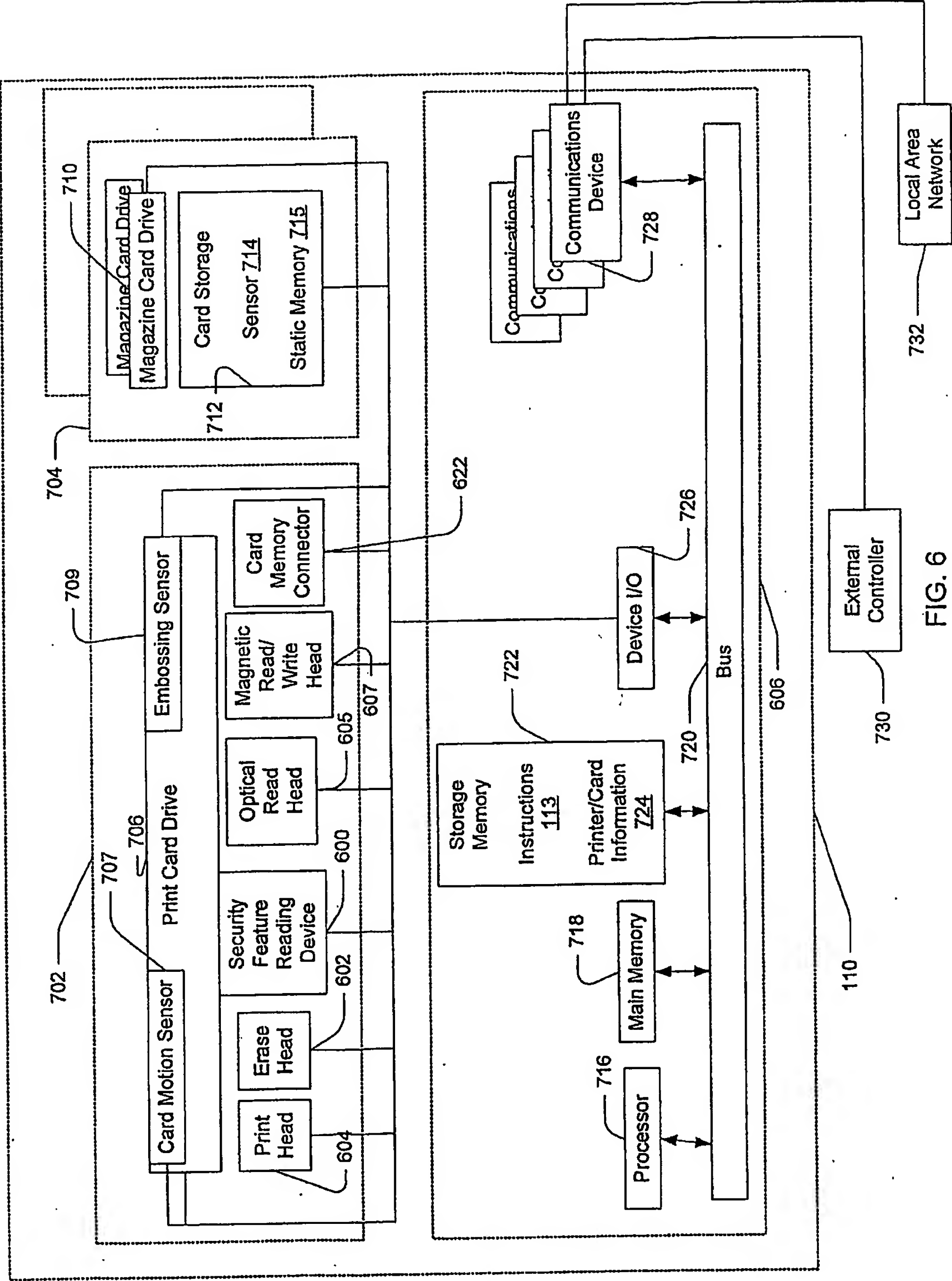


FIG. 6

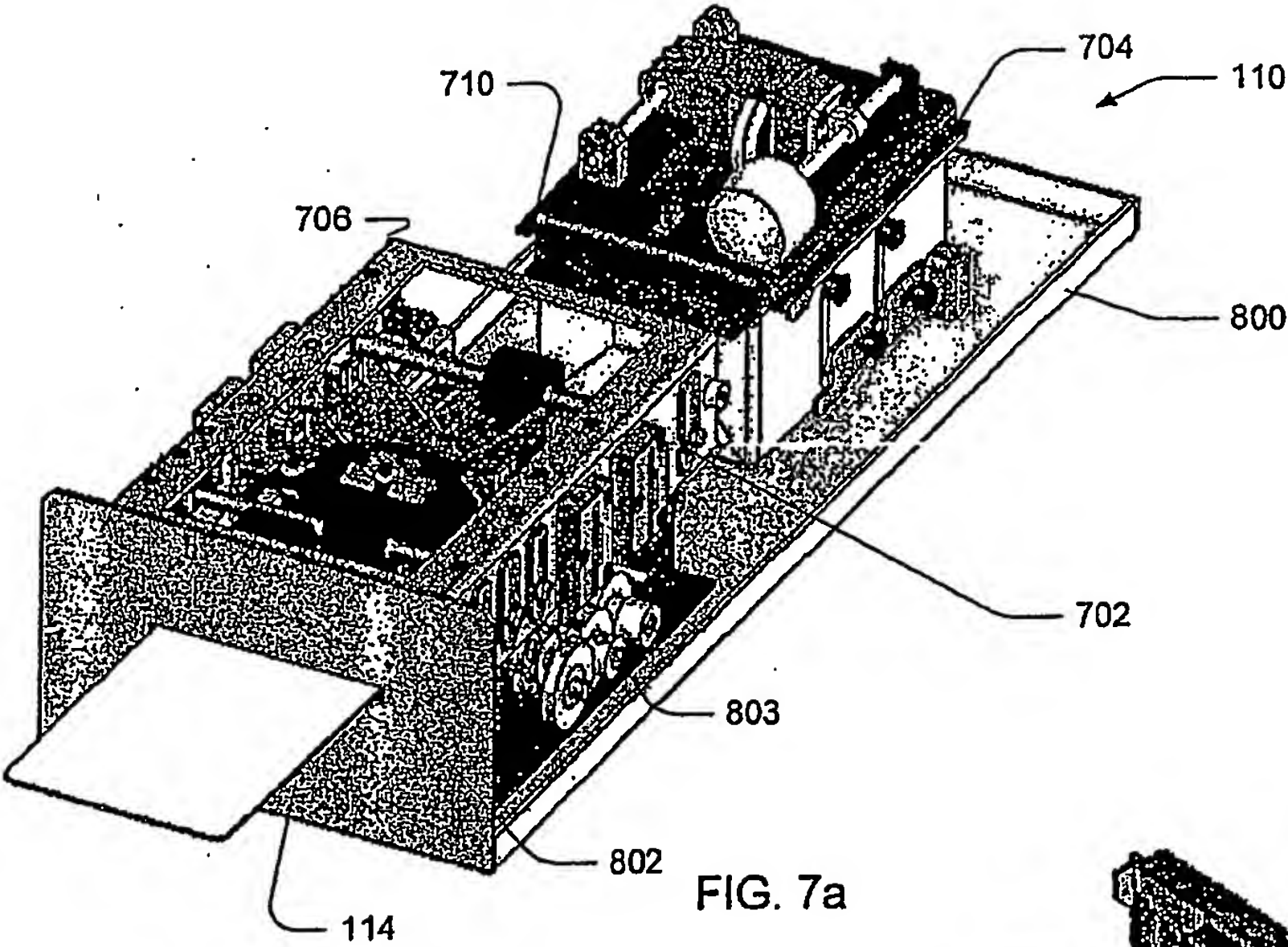


FIG. 7a

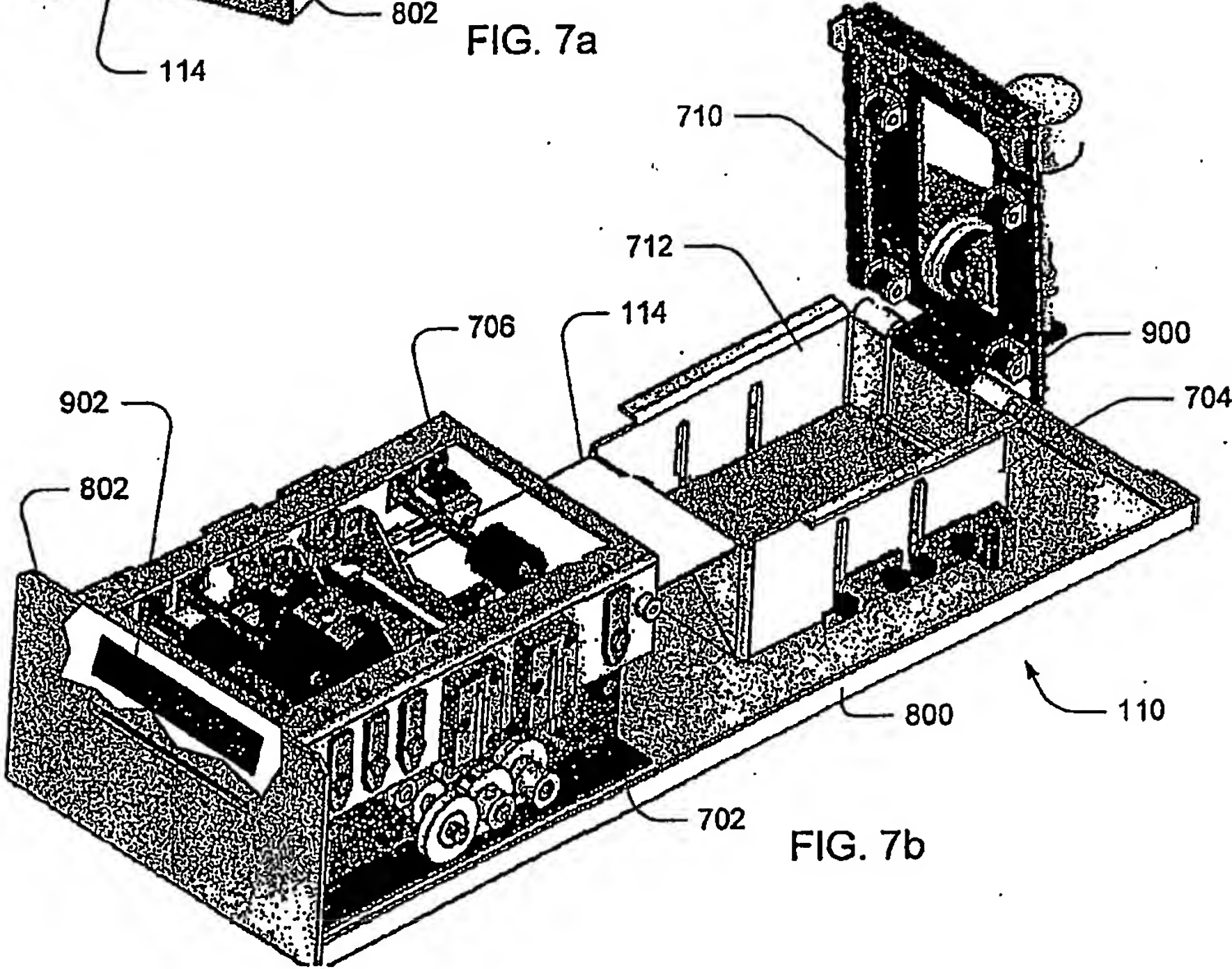
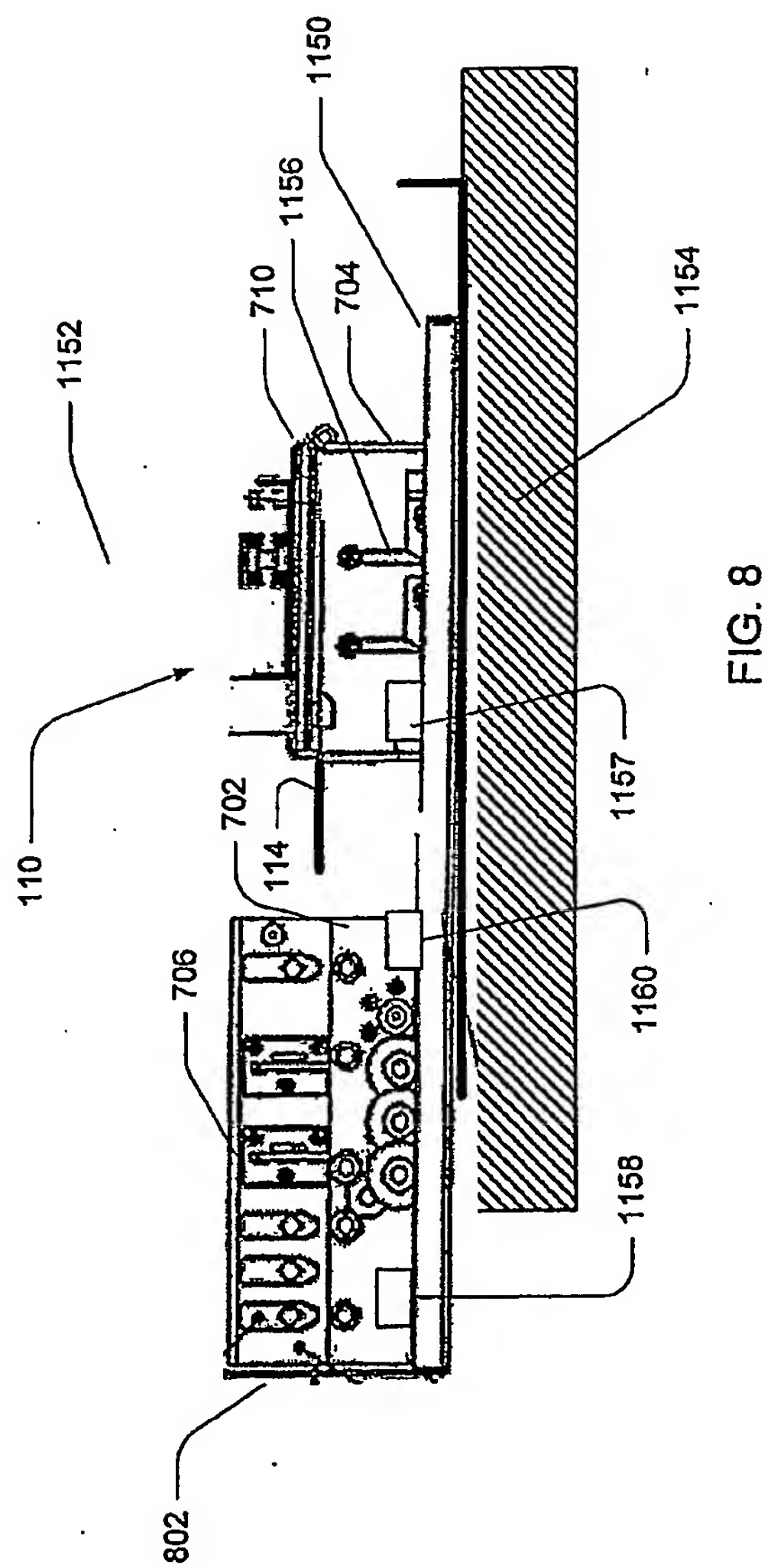


FIG. 7b

BEST AVAILABLE COPY





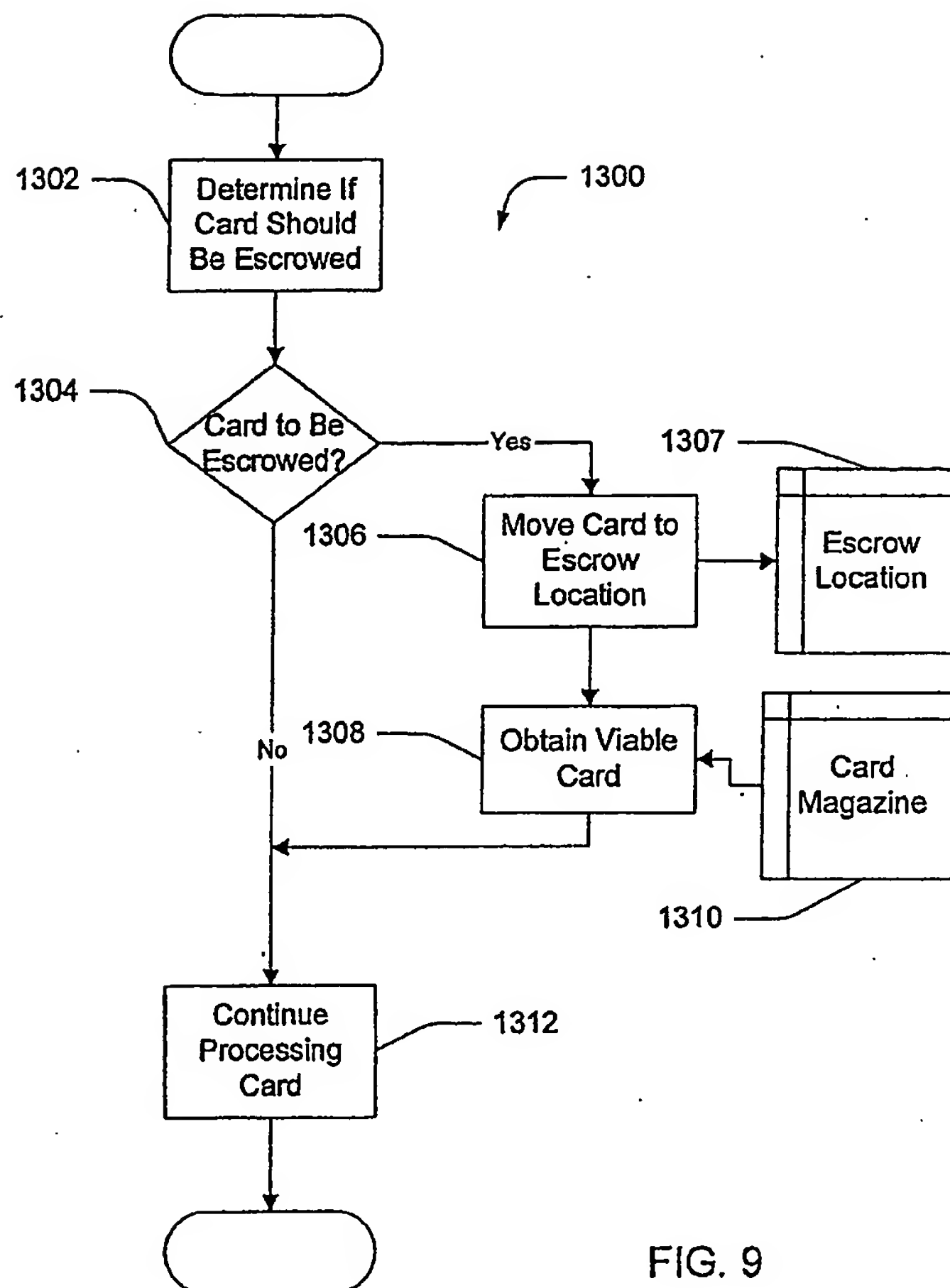


FIG. 9

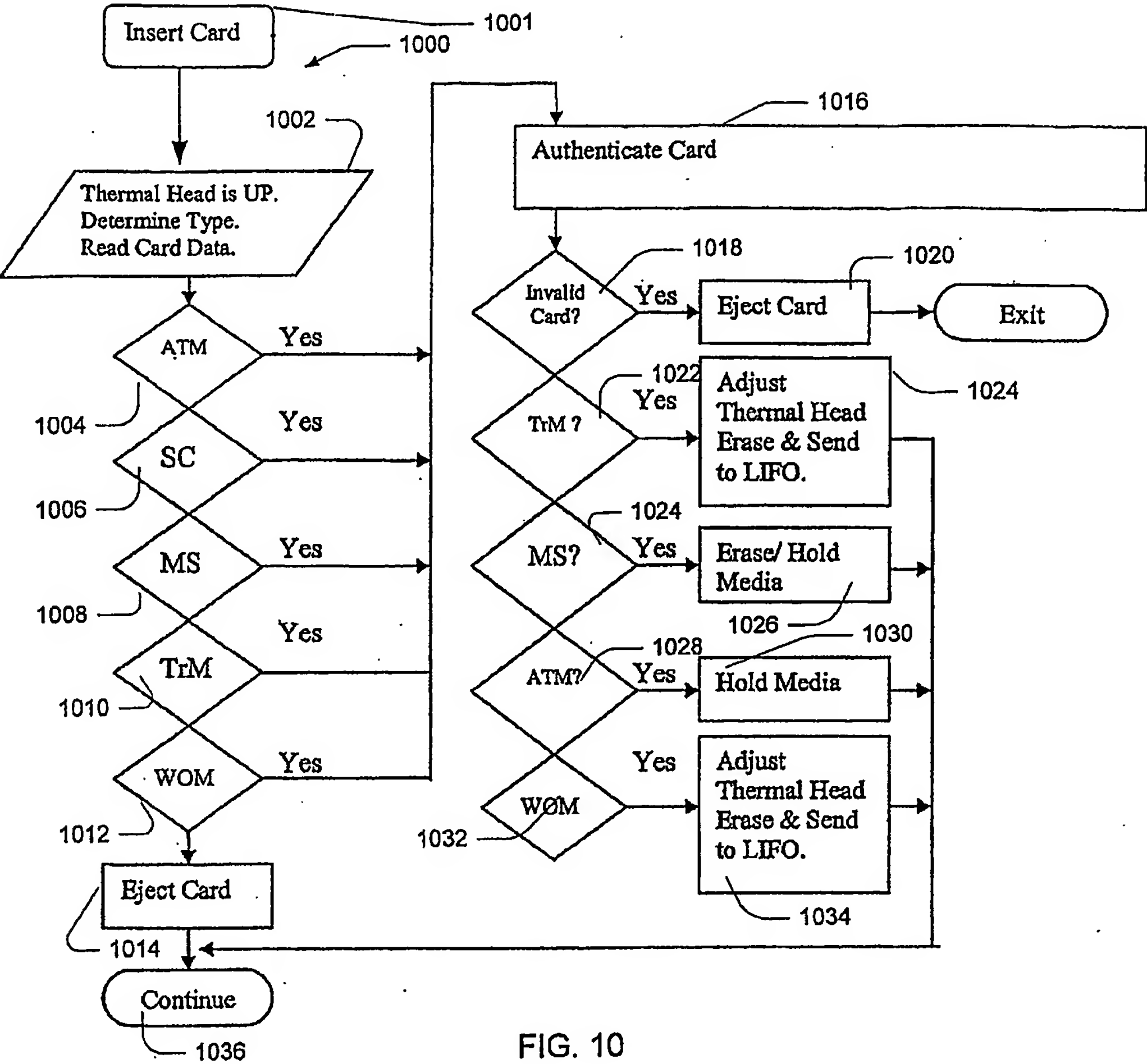


FIG. 10

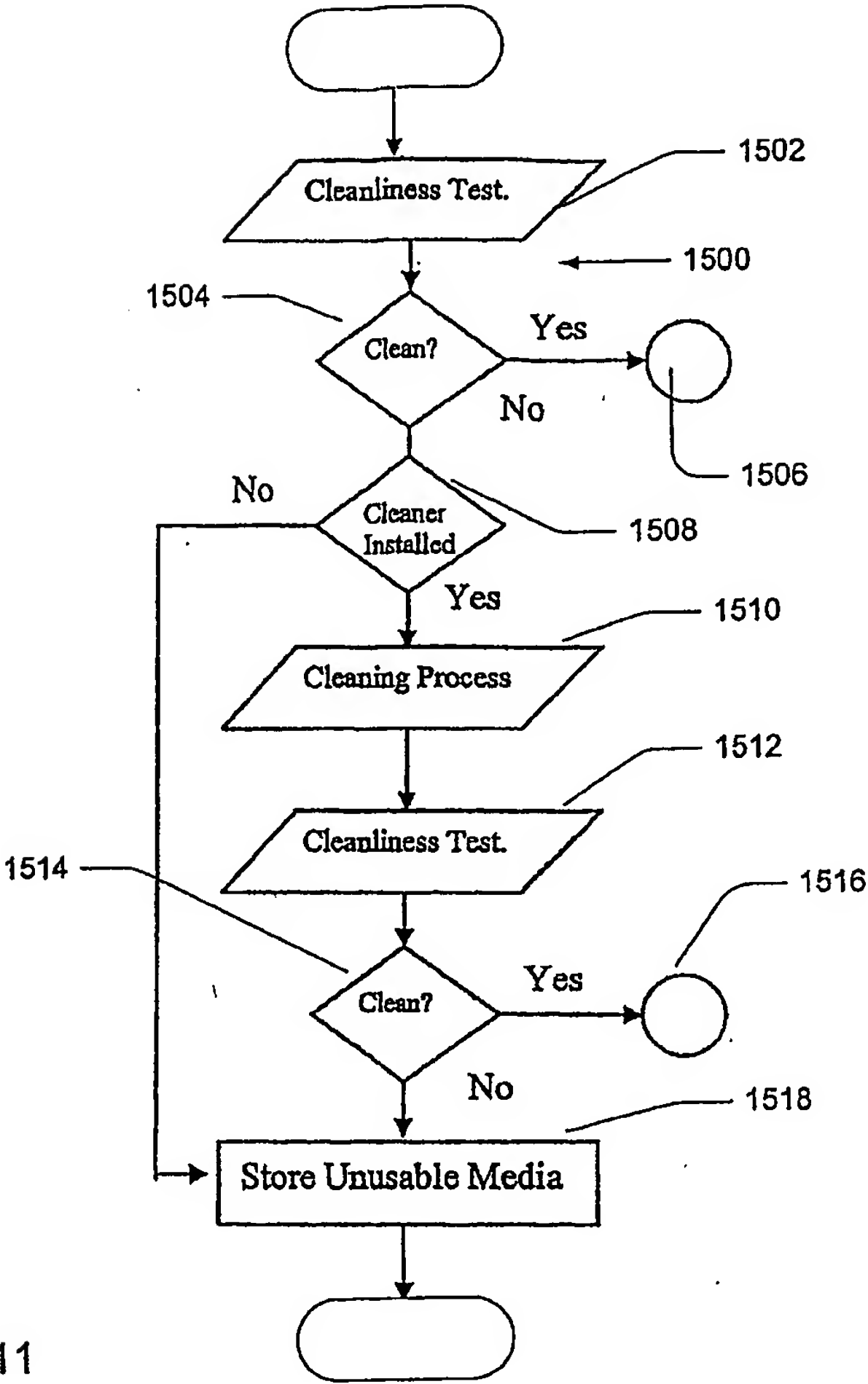


FIG. 11